Space Weather Technical Forecast

Issued on Wednesday, 17 August 2022 at 13:29 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: G1/Minor storm likely Days 1 and 2 (17-18 Aug), chance of G2/Moderate storm. Further Moderate flares (R1-R2 Radio blackouts) likely throughout. Active electron fluence likely declining.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is Moderate with one M-class flare observed in the past 24 hours. This was from AR3078 (Dkc/Beta-Gamma-Delta) in the southwest quadrant (M1.9 at 16/2121 UTC). There are currently ten sunspot regions on the visible disc. AR3078 is the largest and most active region and displays strong spots with a weak delta configuration. AR3081 is the next largest region on the disc, but has been relatively stable and appears to be weakening in recent hours. AR3082 and AR3083 continue to grow, the former being responsible for a C9 flare at 17/0820 UTC. Three regions are approaching the west limb, with another couple of weak regions apparent in the southeast. Most other regions appear largely small and stable for now.

A CME associated with one or more flares in short-succession from AR3078 on the 16th has been analysed and may give a glancing blow to Earth on the 19th, though the bulk of the ejecta appears to pass below Earth. The M1.9 flare late on the 16th does not appear to have produced a CME based on available LASCO and STEREO imagery. The more recent C-class flare may also have produced a CME but we await further imagery to assess this.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, was at slow-ambient levels for much of the period, varying between 350-380 km/s. An increase to slightly elevated levels was observed following the arrival of a CME just after 17/0200 UTC and solar winds now 450-480 km/s. Density initially was at average or below average levels, but rose to average to above average levels with the arrival of the CME. The IMF was weak to start, increasing to Moderate levels after 17/0200 UTC, with a peak of 18nT at 17/0343 UTC. The north-south component varied weakly to begin with but with the CME arrival has varied between +15nT/-9nT, though has mainly been positive. The phi angle has largely been negative (towards the sun). Resultant Geomagnetic activity was Quiet to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV), as measured by GOES16, was at Background levels. The high energy electron flux (greater than 2 MeV) was predominantly High, with a peak of 6.04e3 pfu at 16/2305 UTC. A recent decline to Moderate to High levels has been observed following the CME arrival. The 24-hour integrated electron fluence was above the Active threshold throughout on a largely steady trend, with an observed value of 2.62e8 integrated pfu at 17/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Moderate with a slight chance of High levels. The most likely source region for any larger flares would be from AR3078 in the southwest quadrant.

Solar Wind / Geomagnetic Activity: The combined effect of one or more CMEs that left the sun on the 16th August may give a glancing blow at Earth either late on the 18th (Day 2) or early on 19th (Day 3). Solar winds are currently at slightly elevated levels. Later on Day 1 (17th) Earth

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is expected to connect with the high speed stream from coronal hole 14. Wind speeds are likely to reach elevated levels at around 500-600km/s. Solar winds are expected to remain enhanced through much of this period before perhaps declining somewhat through Day 4 (20th).

Geomagnetic activity is expected to be mainly Quiet at first. During Day 1, activity is expected to become Active to G1/Minor Storm, with a chance of G2/Moderate Storm and a very slight chance of G3/Strong Storms. A gradual decline in activity is expected through Day 4.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is likely to remain at background levels, although with a slight chance of an S1 or greater event mainly due to AR3078.

High energy electron flux will start will start the period at Moderate to High levels, but the anticipated CME and HSS arrivals from Day 1 through to Day 3 (17-19th) are likely to suppress flux levels. A rise is possible once again on Day 4 (20th). Electron fluence values will start above the Active (1e8 integrated pfu) threshold, but are likely to drop sharply with the expected HSS arrival, probably below Active levels. They are most likely to stay below during Days 2 and 3, perhaps with a rise on Day 4.

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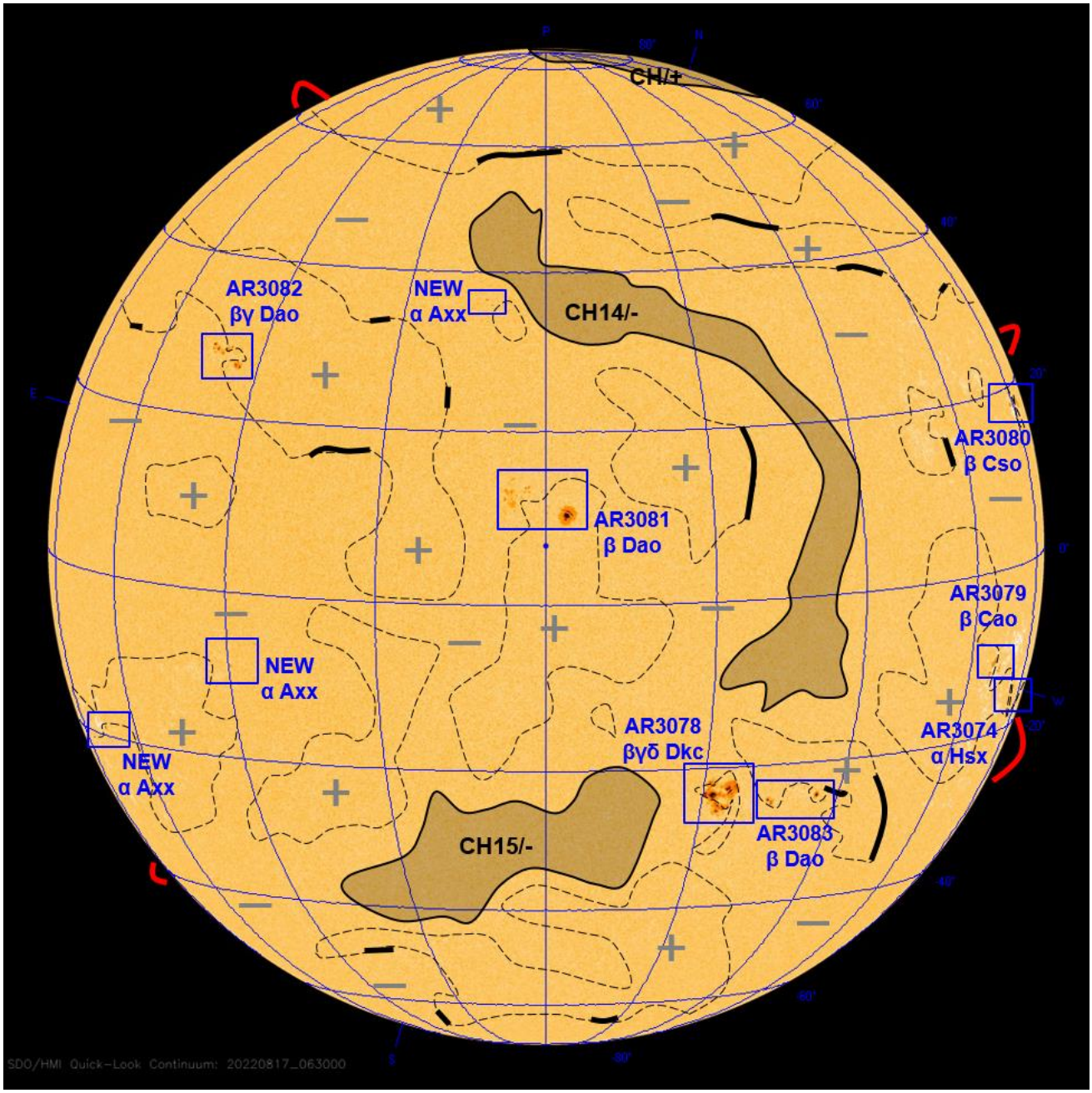
Figure 1. Solar Analysis Valid 17/0630 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The combined effect of one or more CMEs that left the sun on the 16th August may give a glancing blow at Earth either late on the 18th (Day 2) or early on 19th August (Day 3), although the bulk of the ejecta is likely to pass below Earth. Solar winds are currently at slow-ambient levels. Later on Day 1 (17th) Earth is expected to connect with the high speed stream from coronal hole 14. This coronal hole is a recurrent feature and solar winds are indicated by persistence to reach elevated levels at around 500-600km/s. STEREO-A appears to have encountered this feature early on the 16th, therefore expected lag time to earth would suggest an arrival here late on the 16th. Solar winds are expected to remain enhanced through much of this period with the HSS and also with the possible arrival of a second CME Day 2 into Day 3. Wind speeds then perhaps declining somewhat through Day 4 (20th Aug).

Geomagnetic activity is expected to be mainly Quiet at first. During Day 1, activity is expected to become Active to G1/Minor Storm, with a chance of G2/Moderate Storm and a very slight chance of G3/Strong Storms. A gradual decline in activity is expected through Day 4.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	70	50	40	5
Strong	G3	No	5	3	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
16/0740 UTC	Partial	AR3078	South centre disc	607 km/s	19/0001 UTC +/- 12 hours	Glancing blow possible

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Met Office Space Weather Technical Forecast

Radio Blackouts - X-Ray Flares:

Solar activity is currently Moderate, mainly due to activity from AR3078 (Dkc/Beta-Gamma-Delta). Activity is likely to remain Moderate, with a slight chance of becoming High over the coming days. Other regions of interest include the developing AR3082 (Dao/Beta-Gamma) in the northeast quadrant as well as AR3083 (Dao/Beta) in the southwest and AR3081 (Cso/Beta) near the centre disc. However, these areas have significantly less magnetic complexity than AR3078 and as such have a lower flare risk. Other regions appear to be stable or in decay. There is a slight reduction in flare probabilities into Day 4 as a few of the current sunspot regions are expected to have rotated over the sun's western limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	60	60	60	50
Very Active	R3 to R5 X Class	No	10	10	10	10

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at Background levels, and is likely to remain at this level through the period. AR3078 carries the main, albeit slight, risk of proton events and as it transits further westward, the risk increases very slightly through the period. There is a very small contribution to the risk from AR3079 and AR3081.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	10	15	15	15
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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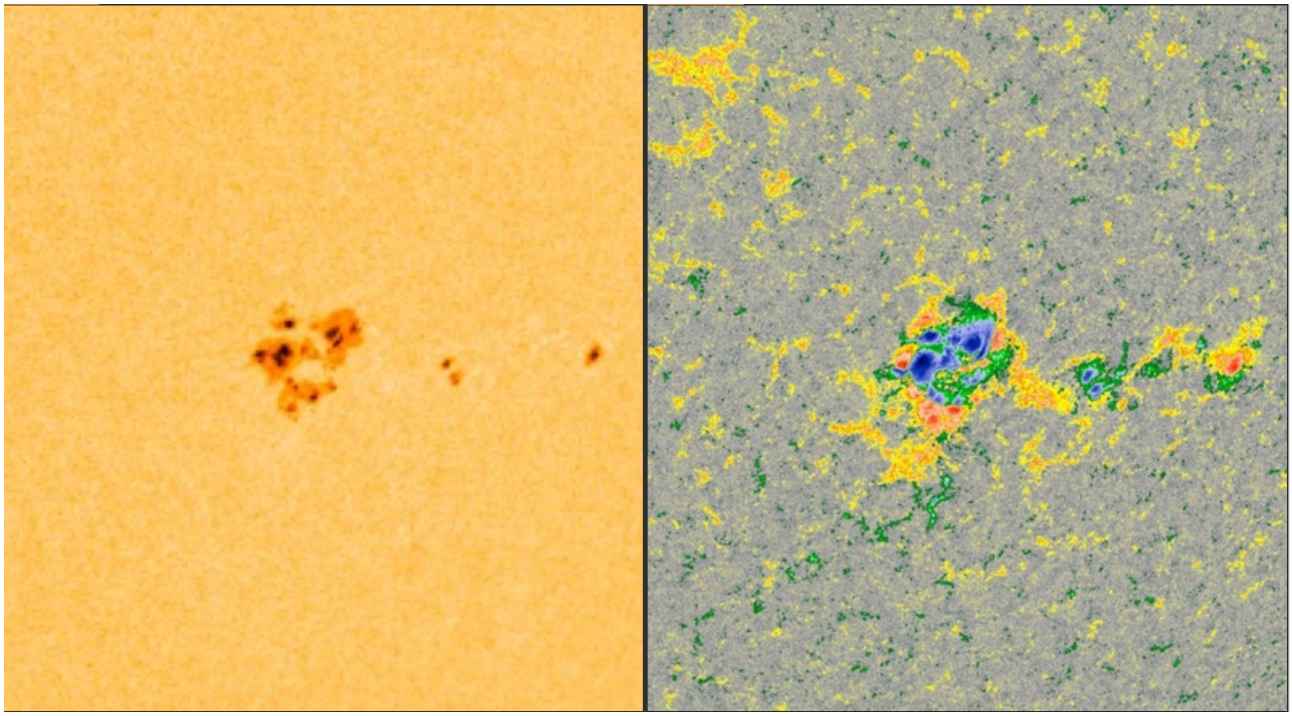
Figure 3: SDO HMI-IC-Flat and HMI-Magnetogram-Color showing AR3078 (centre) with AR3083 (right)



High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) will start the period at Moderate to High levels. During Day 1 (17th) the HSS arrival is expected with coronal hole 14 is expected to suppress flux levels due to both geomagnetic effects and deformation of the van Allen belt. A further potential CME arrival later Day 2 or early Day 3 (18-19th) may continue the suppressed flux levels. A rise is possible once again on Day 4 (20th) as geomagnetic activity begins to subside.

Electron fluence values will start above the Active (1e8 integrated pfu) threshold, but are likely to drop sharply with the expected HSS arrival, probably below Active levels. They are most likely to stay below during Days 2 and 3, perhaps with a rise on Day 4. REFM forecast values are currently too low, and this model won't be taking account of the likely CME arrivals. As such although it is forecasting a decline and looks like it is currently showing a trend in line with the forecast above, this will be for the wrong reasons and therefore REFM should not be relied upon through this period.

GEO Electron Environment	Level ($cm^{-2}\ sr^{-1}\ day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	100	40	20	30
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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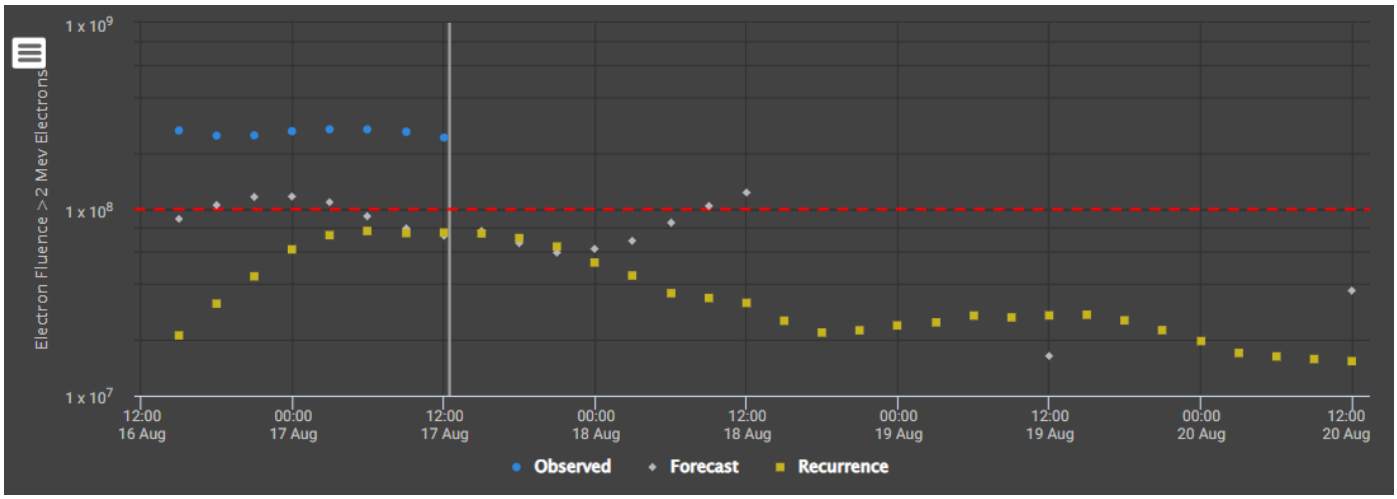
Figure 4: MOSWOC REFM output



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